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Global leader in Advanced Leak Detection, Emissions Management and Pipe Replacement Optimization

ICC Pipeline Safety Conference 2021

Advanced Leak Detection Solution
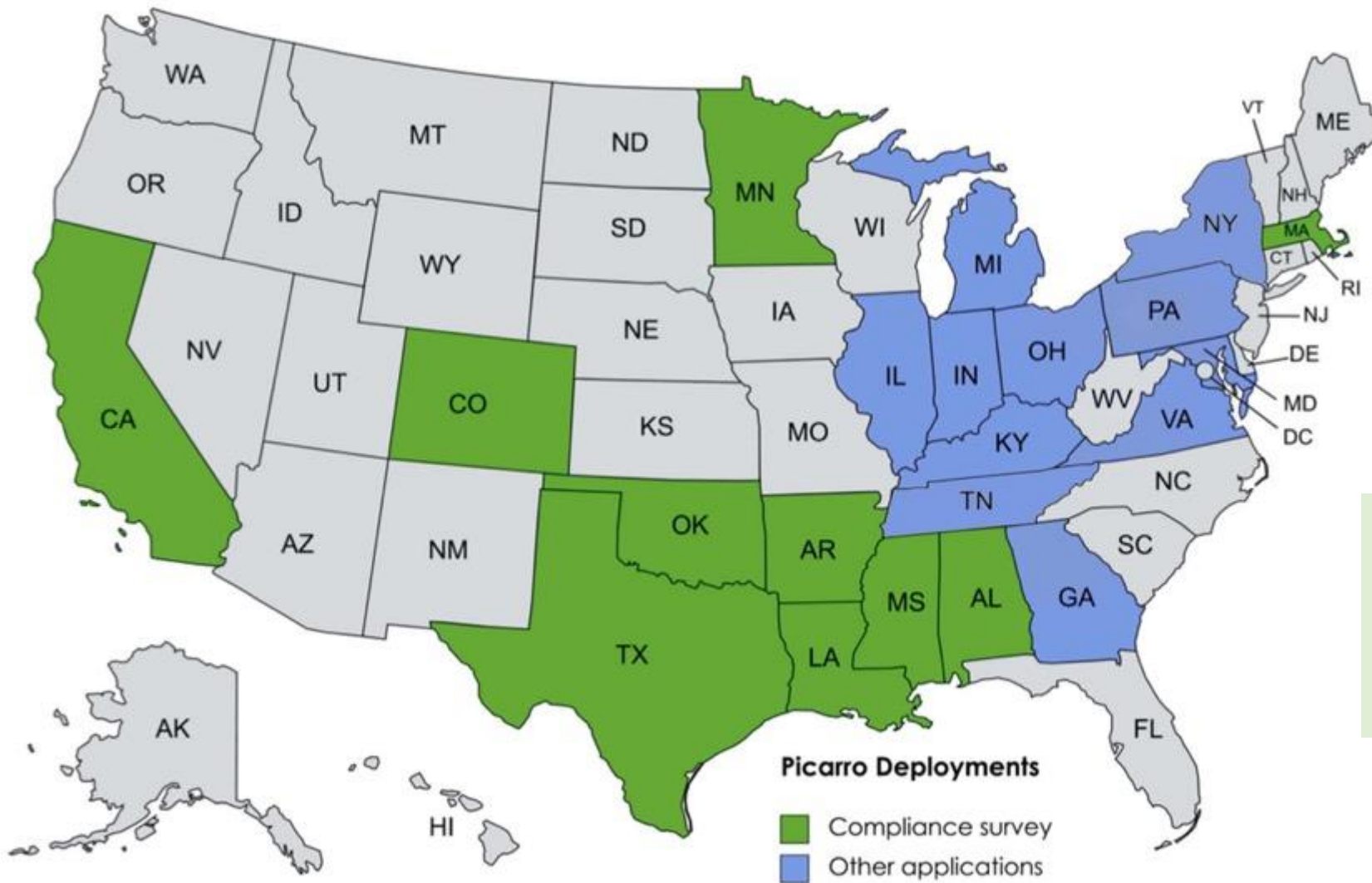Addressing Safety & Emissions

PICARRO ANALYTICS

✓ Millions of miles driven
✓ Billions of methane datapoints
✓ Millions of quantified leaks

U.S. Deployment Summary

30 natural gas operators **worldwide** currently use the Picarro solution

Picarro Deployments

- Compliance survey
- Other applications

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Hardware-Enabled Data Analytics

Advances in **mobile leak detection technology** allow natural gas emissions data to be collected at a **speed** and **scale** not previously possible

Advances in **"Big Data" Analytics** allow **better-informed conclusions** to be drawn from that data and action taken
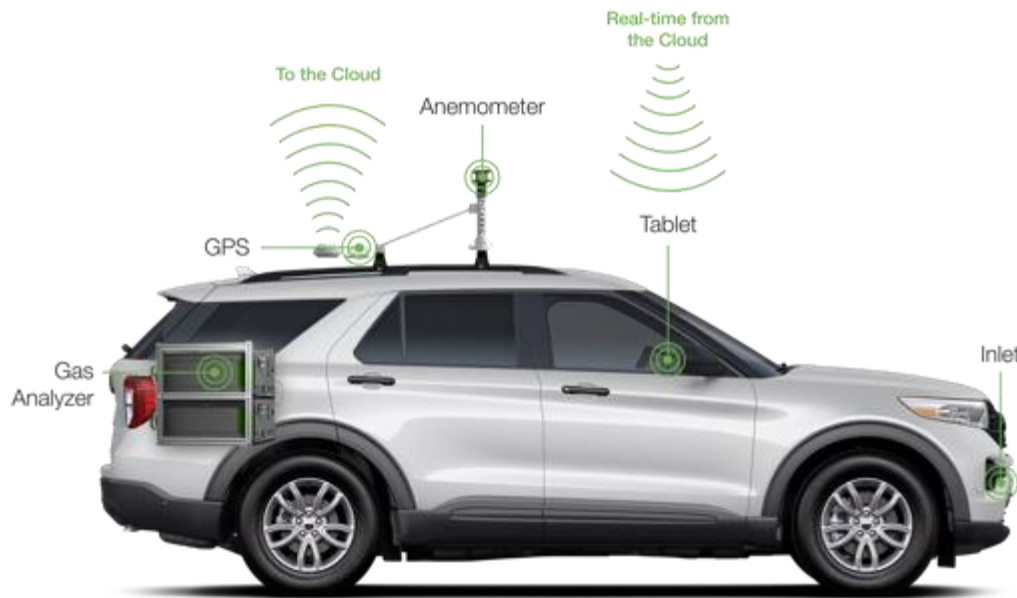
Emissions Data
Collection

Emissions Data Management,
Analytics, Visualization & Reporting

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P-Cubed Software & Analytics Platform

Data Collection

Cloud Hosted Data Warehouse & Analytics

Picarro Systems

P)CUBED®

- ✓ Cloud Hosted Platform
- ✓ Geospatial Analytics
- ✓ Data Security
- ✓ Secure APIs

SOC2 - ISO 27K

Reports

Operations Dashboards

GIS Interface - ESRI
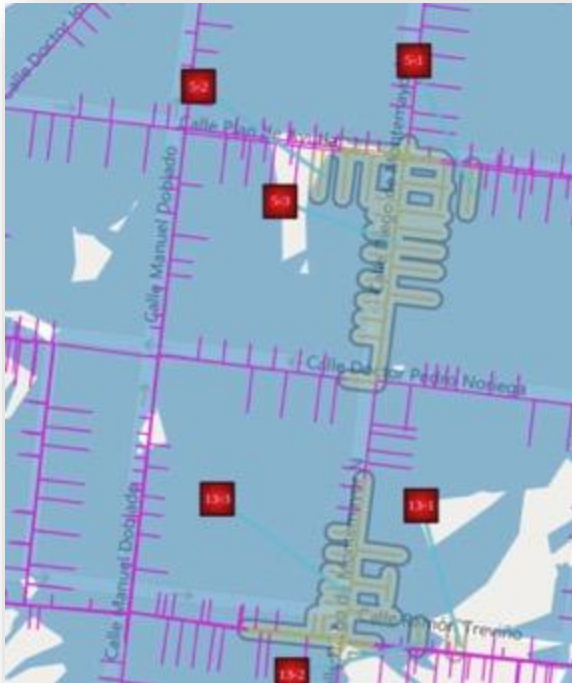
Mobile App

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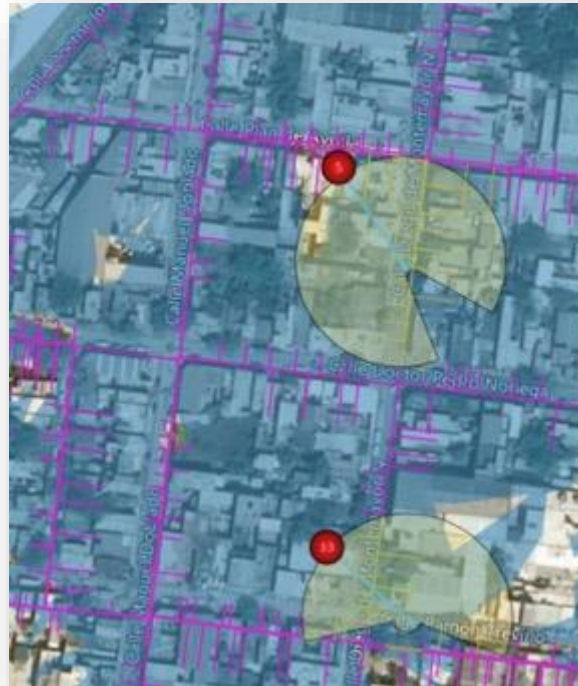# Custom Report Outputs and Mobile App

Easily & clearly visualize the data and locate leaks:

– Street maps and satellite maps

– Mobile application for phones & tablets

– GIS data for import into other gas company systems (like ESRI)
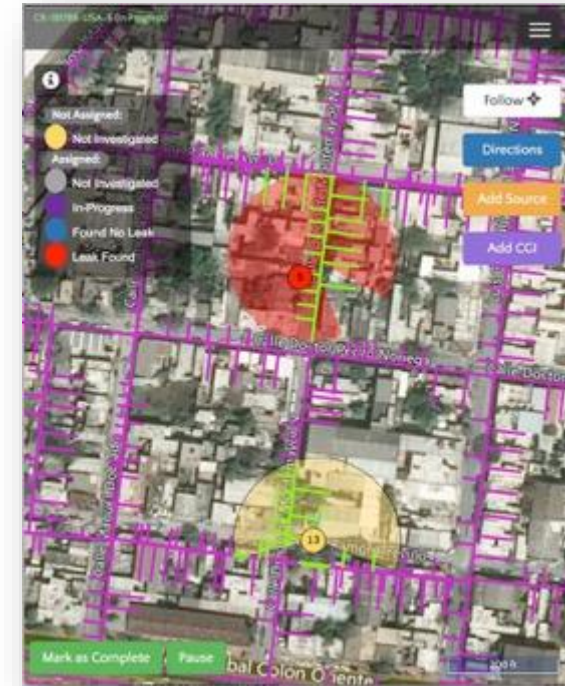
– ESRI web app and other dashboards

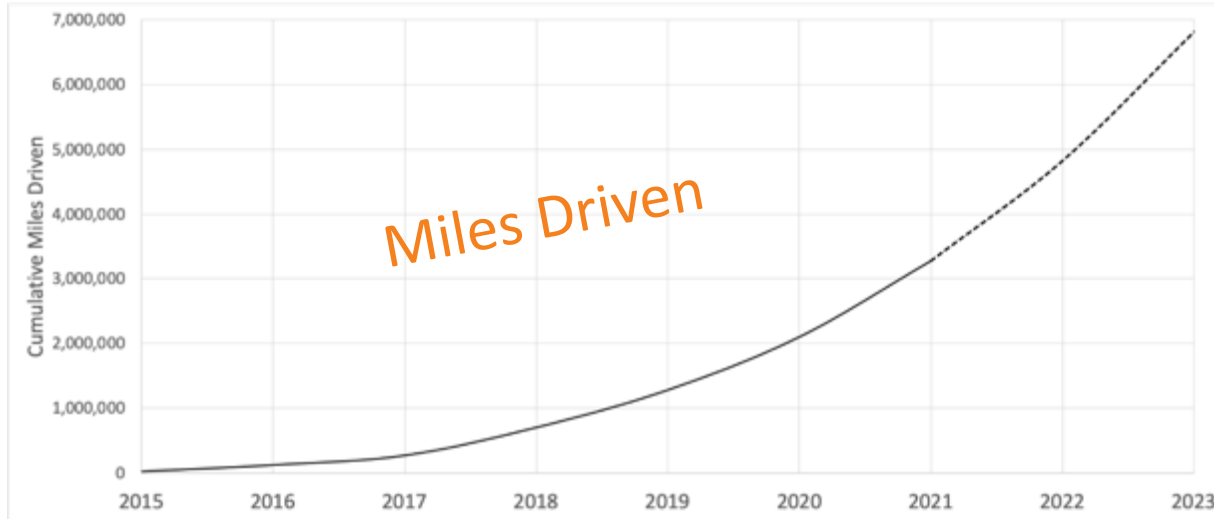**GIS boxes**

Search areas

Mobile app

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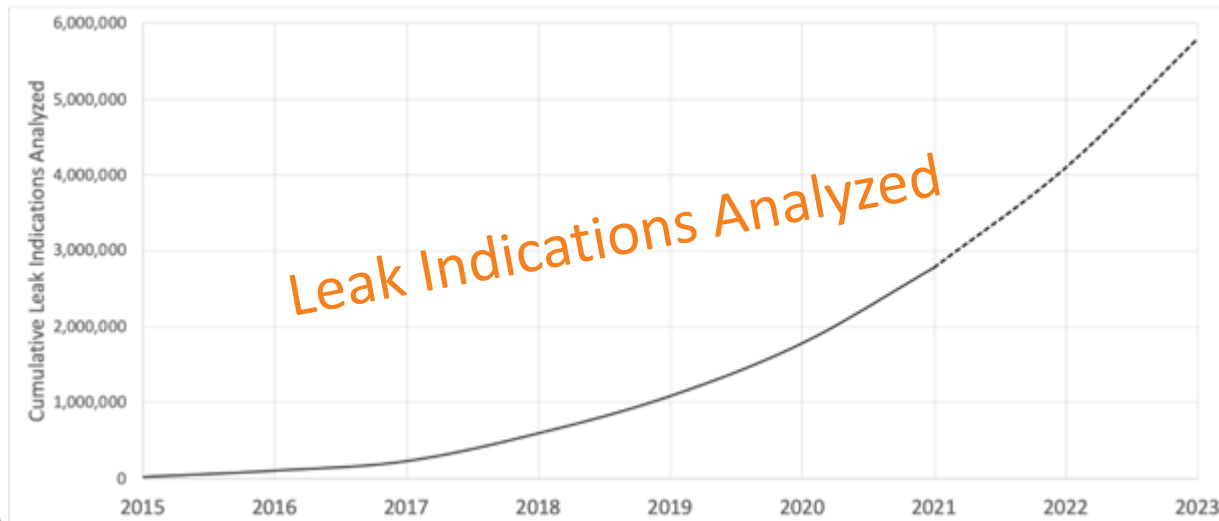# Picarro's Analytics Using Machine Learning

Cumulative Values Since 2015

Cumulative data collection miles driven by Picarro since 2015:

>3M miles to date

Both are accelerating and projected to DOUBLE by 2023

Cumulative leak indications analyzed by Picarro since 2015:
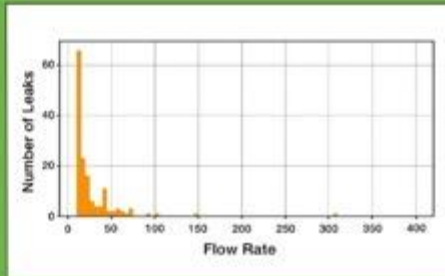
~3M indications to date

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PICARRO ANALYTICS

EMISSIONS REDUCTION

Geo-Locating Super Emitters

yields

50% Emissions Reduction

PIPE REPLACEMENT
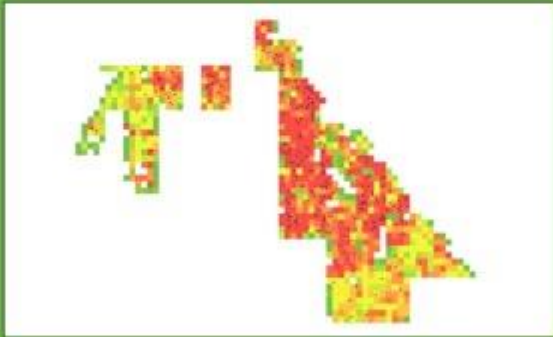
Methane Data Mapping

yields

Replacement of Leakiest Pipes

ADVANCED LEAK DETECTION
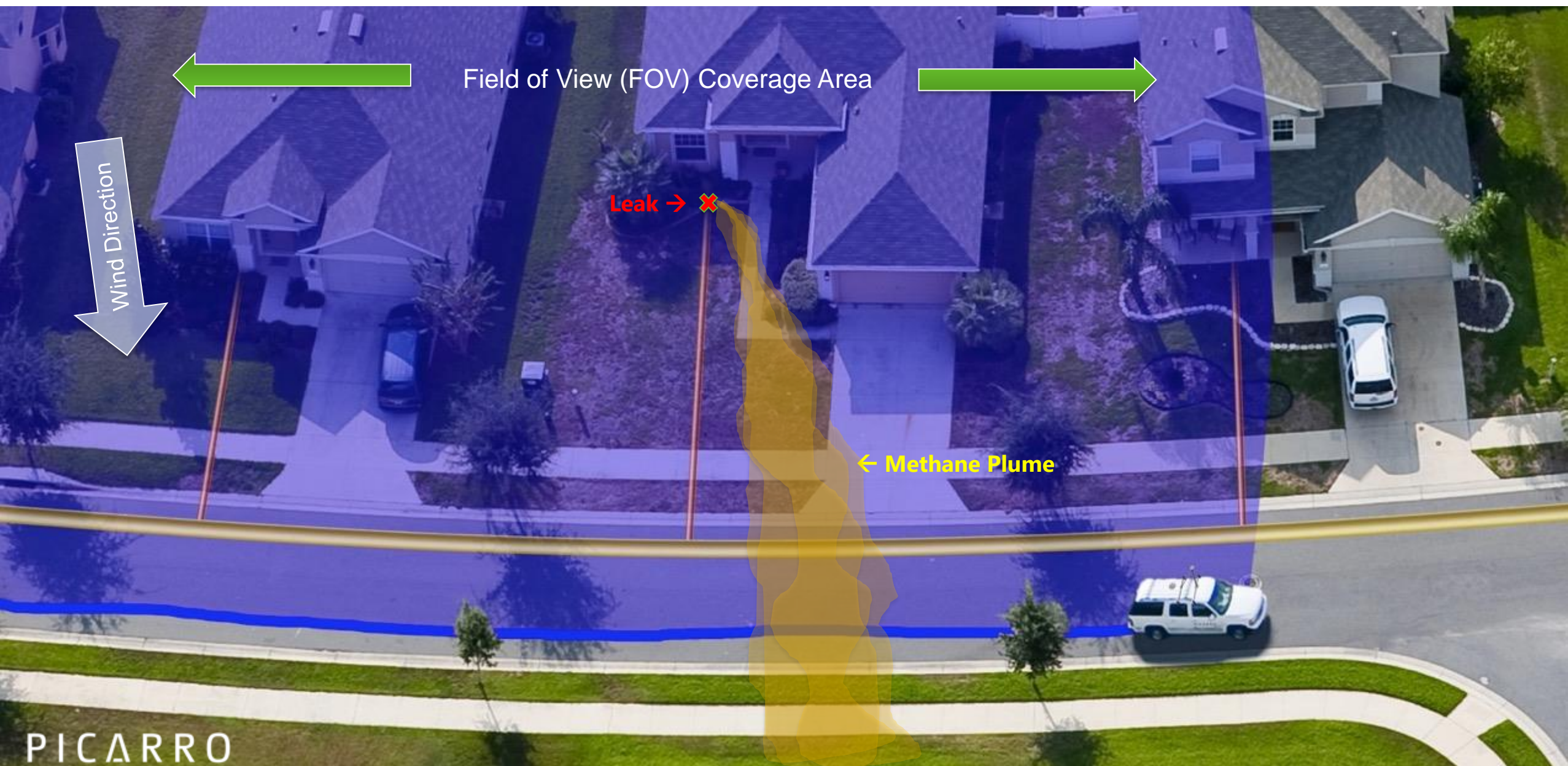
Risk-Based Survey

yields

3X Hazardous Leaks

Advanced Leak Detection & Compliance Leak Survey

Detecting Distant Leaks

- Traditional leak survey equipment has PPM methane sensitivity & requires the detector to be within ~3ft to detect the leak because the gas dilutes quickly in the atmosphere
- Picarro detects leaks at a larger distance (>600ft) which requires very high PPB methane sensitivity and wind direction measurements to find the leak location

Typical Plume Dilution at a Distance

0.5% Gas Here

100% Gas Here

Methane Plume

1ppm Here

1ppb Here

0'   Leak   200'   400'   600'

Traditional detectors must be within ~3ft to detect leak

Picarro technology detects methane with PPB sensitivity >600ft from leak source

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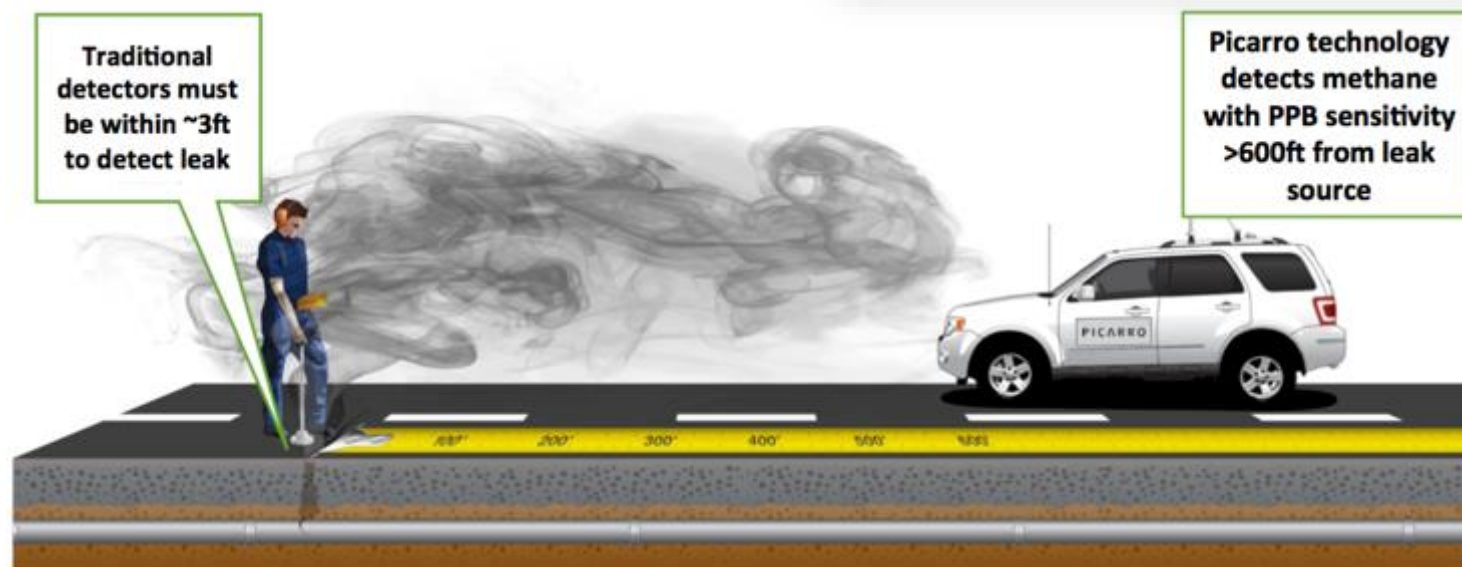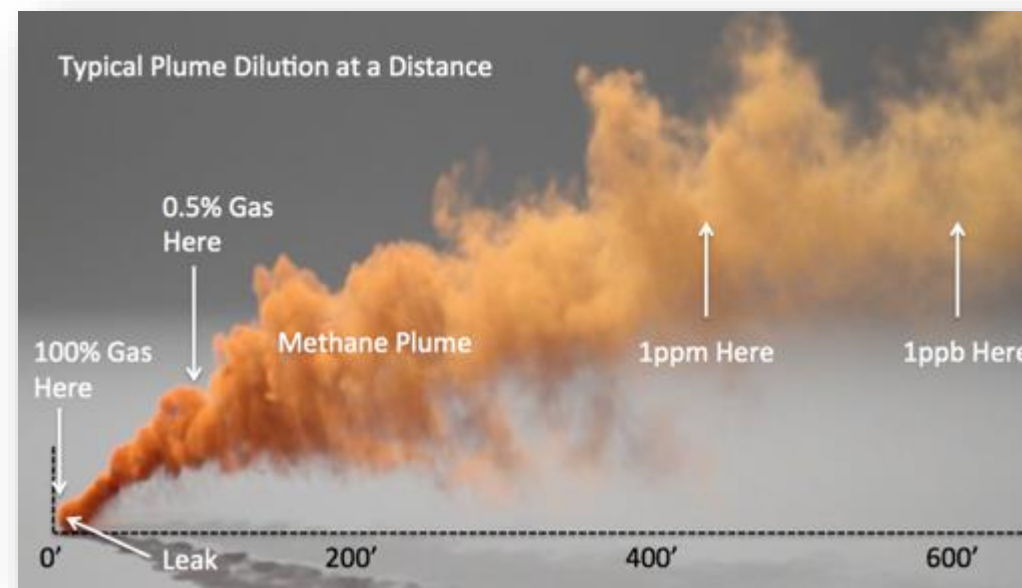
Advanced Leak Detection Compared to Traditional Walking and Mobile Survey

Traditional Leak Survey — COVERAGE AREA · LEAK DETECTED · LEAK NOT DETECTED · WIND · NATURAL GAS NETWORK
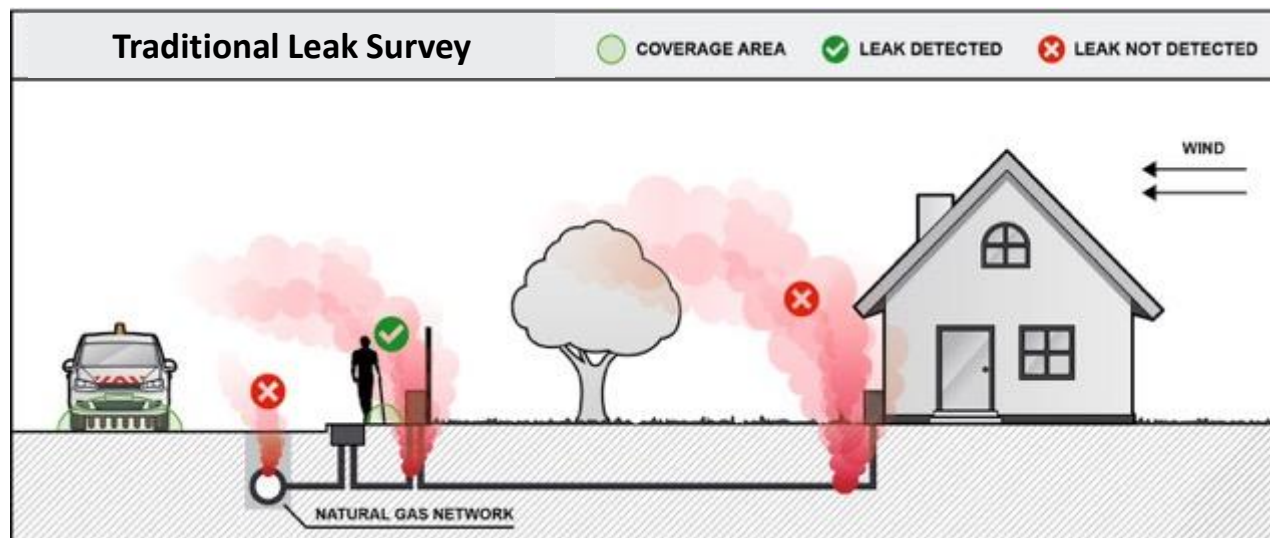
Disadvantages:
- Only PPM sensitivity
- **Only detects ~32% of hazardous leaks**
- Limited coverage: must be directly over pipelines
- Detects only methane
- Depends on skill of technician
- Cannot use in rain/snow
- Slow walking & driving speeds

Advanced Leak Survey — COVERAGE AREA · LEAK DETECTED · LEAK NOT DETECTED · COVERAGE AREA ≈ 200M · WIND · NATURAL GAS NETWORK · PICARRO
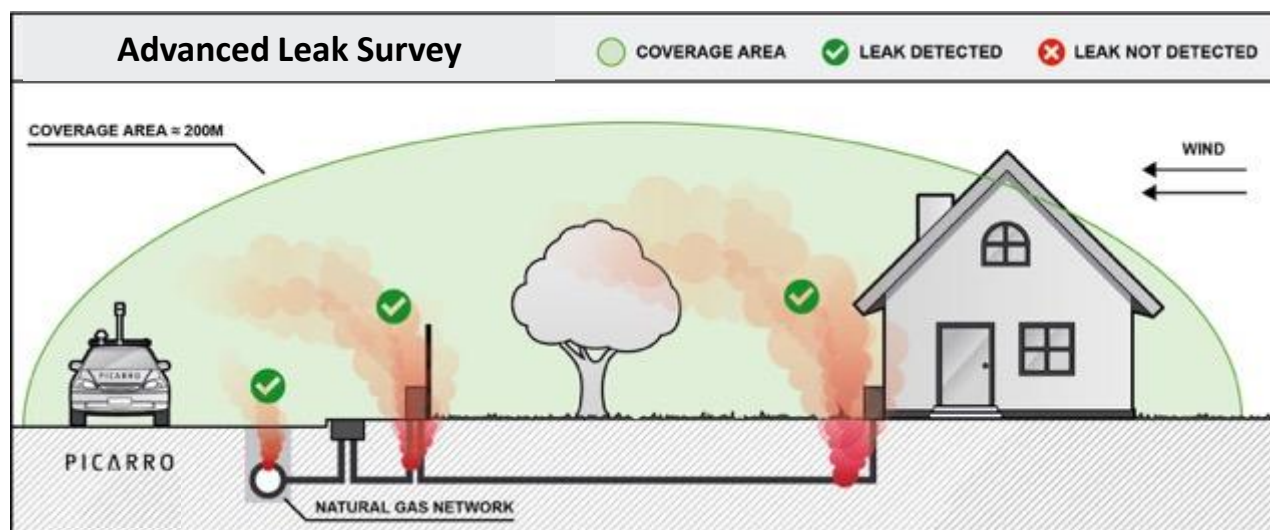
Advantages:
- PPB sensitivity
- Large coverage area
- **Detects ~91% of hazardous leaks**
- Detects methane & ethane: discriminates natural gas from sewer gas
- Not influenced by human error
- Detects leaks on the entire network (mains, services & meters)
- Can use in rain/snow
- Can drive at high speeds

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ALD for Leak Survey

Drive 1

Drive 2

Drive 3

Data from **multiple drives** combined and processed by **Analytics** to determine:

- **Search Areas**
- **Source Attribution**
- **Field of View Coverage**

Drives 1,2,3 data processed by analytics

Natural Gas

← Search Area

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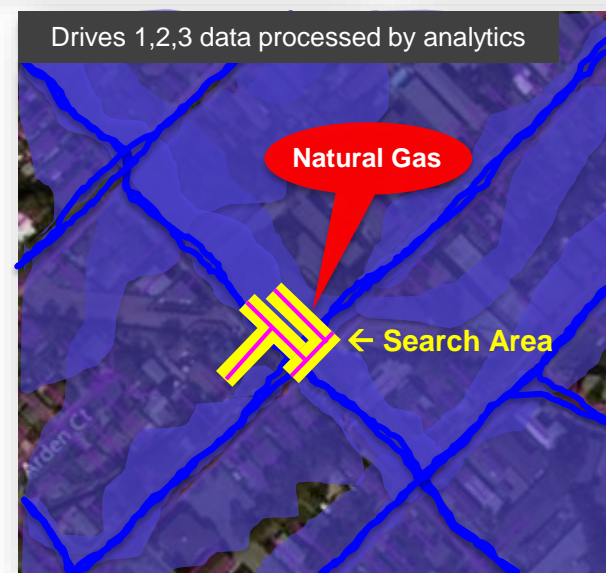
2X Faster Leak Survey, Yields 3X More High-Grade Leaks

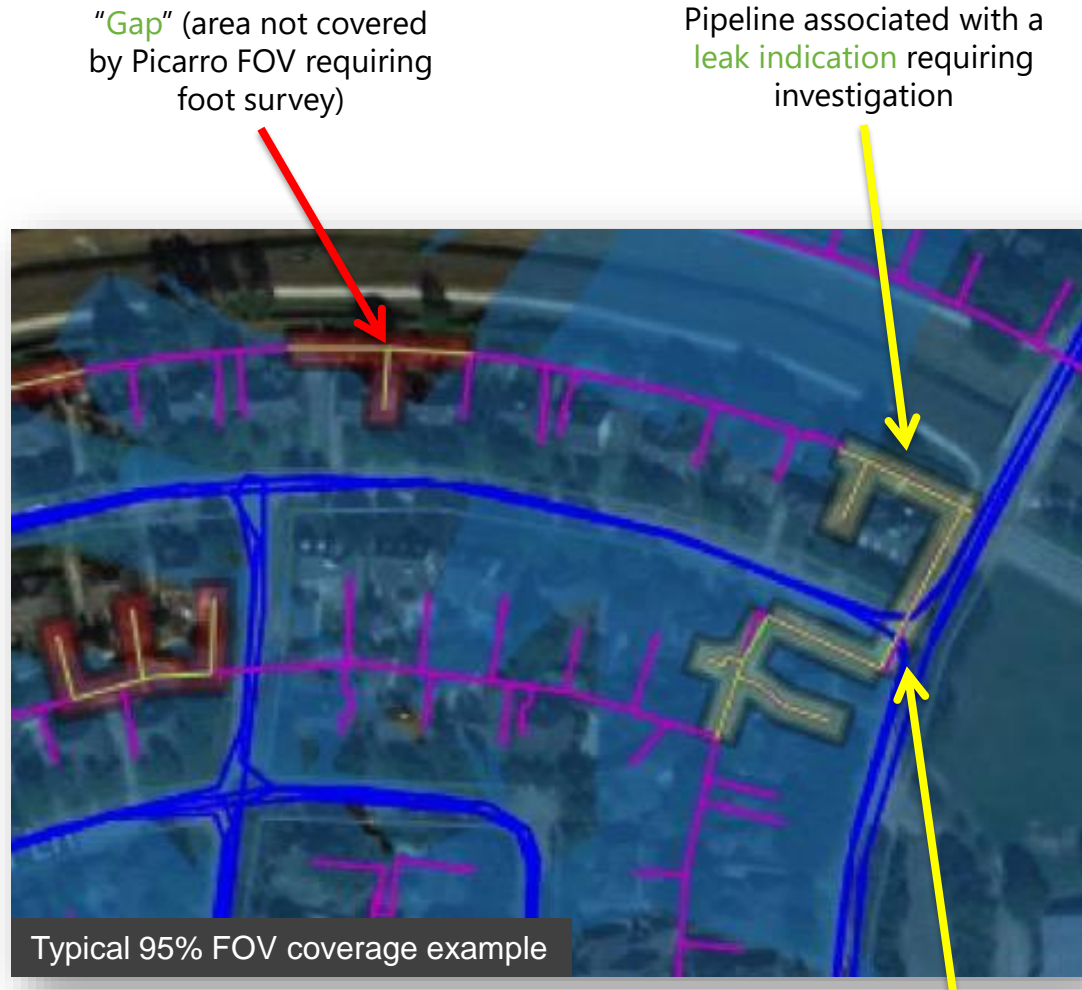"Gap" (area not covered by Picarro FOV requiring foot survey)

Pipeline associated with a leak indication requiring investigation

Typical 95% FOV coverage example

95% FOV coverage → only need to walk **5% in Gap + investigate leak indications**

Example area:
10 miles of main / 500 services:

– 5.7 hrs to drive
– 25 Gap services* = 1.8 hrs
– 2 leak indications /mi
@ 25 min/indication = 8.3 hrs

15.8 hrs Picarro process
- vs. -
36.2 hrs traditional survey

*Typical traditional survey rate of 13.8 services/hr

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Picarro & Traditional Leak Survey Performance Comparison

Picarro is 2x faster and 3x more effective than traditional survey

	Picarro	Traditional	Notes
Gradeable Leak Find Rate*	89%	36%	All categories of reportable leaks
Hazardous Leak Find Rate	91%	32%	Hazardous leaks defined as Grade 1, 2+, 2 or Grade A, B depending on utility grading criteria
Survey Coverage	90%	Undefined	Picarro "FOV" coverage. Traditional technologies do not calculate coverage
Survey Speed (mains)	0.45	0.22	Mains pipeline mi/hr *including* services
Survey Speed (services)	28	13	Services/hr including associated mains

- This performance is based on data collected in 50 Field Trials conducted since 2011 with 30 utilities worldwide.
- *100% "leak find rate" is defined as the population of all leaks in an area found by Picarro survey plus all leaks found by traditional survey.
- Anonymized, detailed results data on each of these 50 trials is available upon request.

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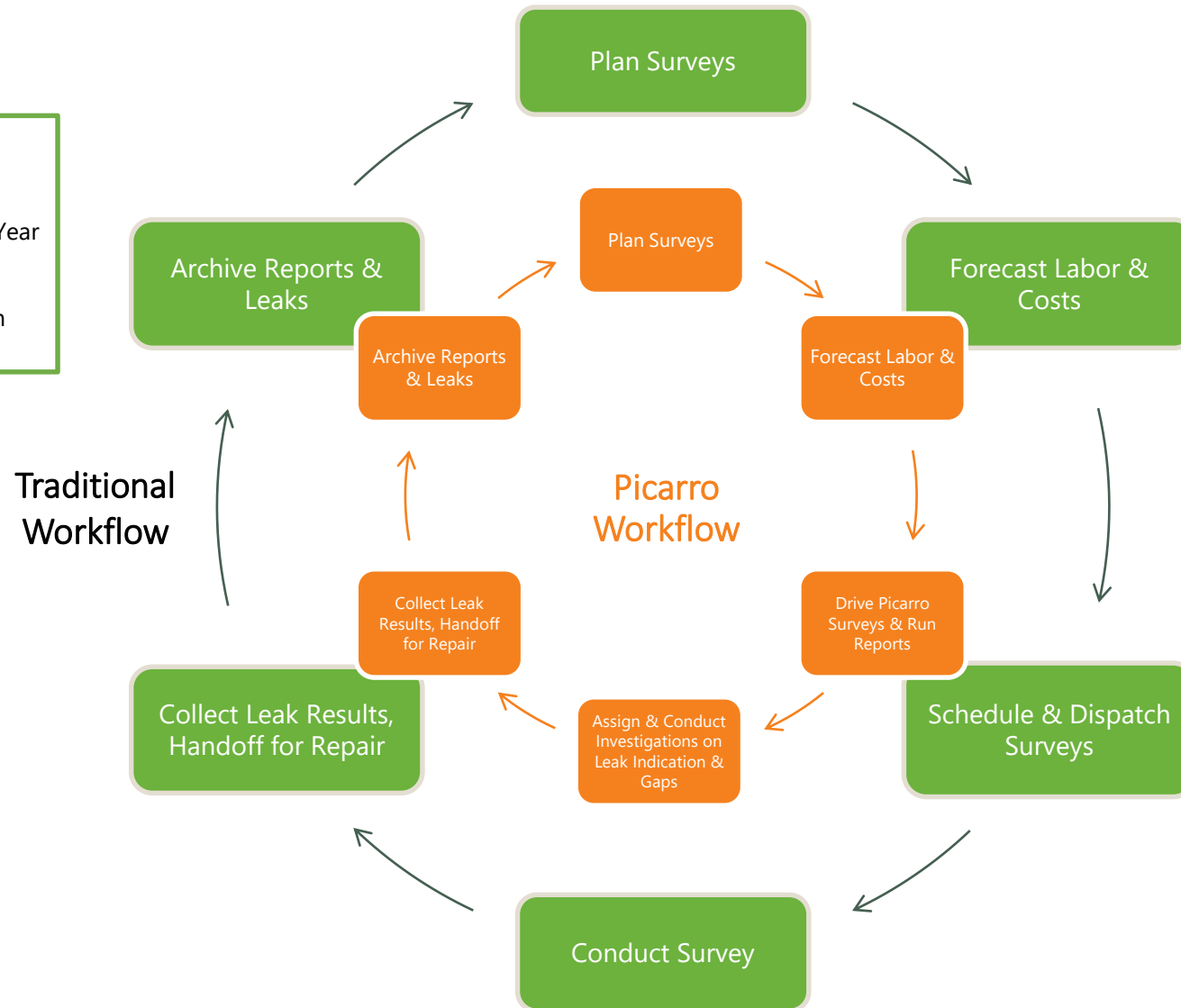# Picarro Process Flow Comparison: Regulatory Compliance Leak Survey

Picarro Capacity Metrics:
- 1 Driver per Car
- 0.3 additional FTEs per Car
- 3000 Pipeline Miles per Car per Year
- Survey speed:
  Picarro: 28 services/hr, 40mph
  Traditional: 13 services/hr, 3mph

Picarro Efficiency Metrics:
- 2x higher process efficiency
- Finds 2-3x more priority leaks
- 75-90% less walking
- 85% fewer "can't-get-ins"

Traditional Workflow

Picarro Workflow

Plan Surveys

Forecast Labor & Costs

Schedule & Dispatch Surveys

Conduct Survey

Collect Leak Results, Handoff for Repair

Archive Reports & Leaks

Plan Surveys

Forecast Labor & Costs

Drive Picarro Surveys & Run Reports

Assign & Conduct Investigations on Leak Indication & Gaps

Collect Leak Results, Handoff for Repair

Archive Reports & Leaks

Methane Data: Applications Beyond Leak Survey

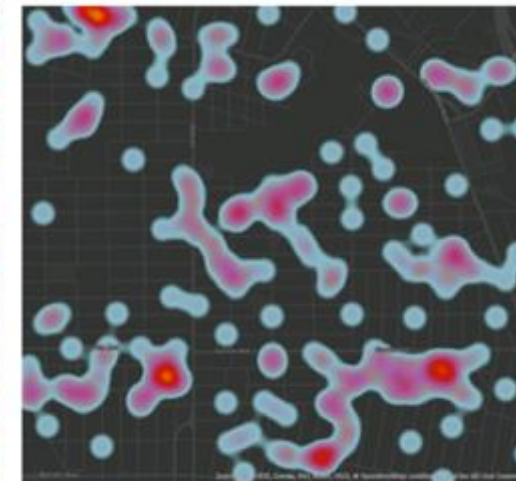Data collected once... ➡ ...used for multiple applications to deliver operational value

	Individual Emitters	Emissions by Pipe Segment	Emissions Heatmap
Analytical Model			
Visualization			
Application	Remediate Super Emitters	Pipe Replacement Optimization	Risk Mapping, Forecasting

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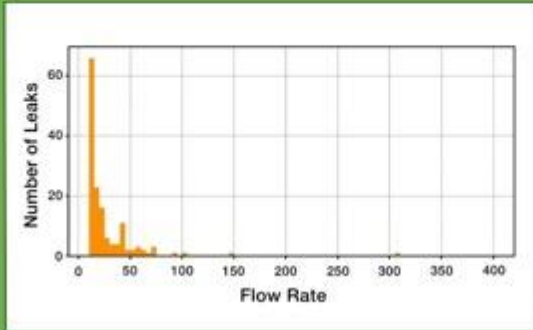
Super Emitters

Super Emitter Program

- Leverage leak survey drive data or independently drive system to capture data

- Measure and quantify emissions across the gas distribution system

- Identify super emitting leaks and target them for accelerated repair

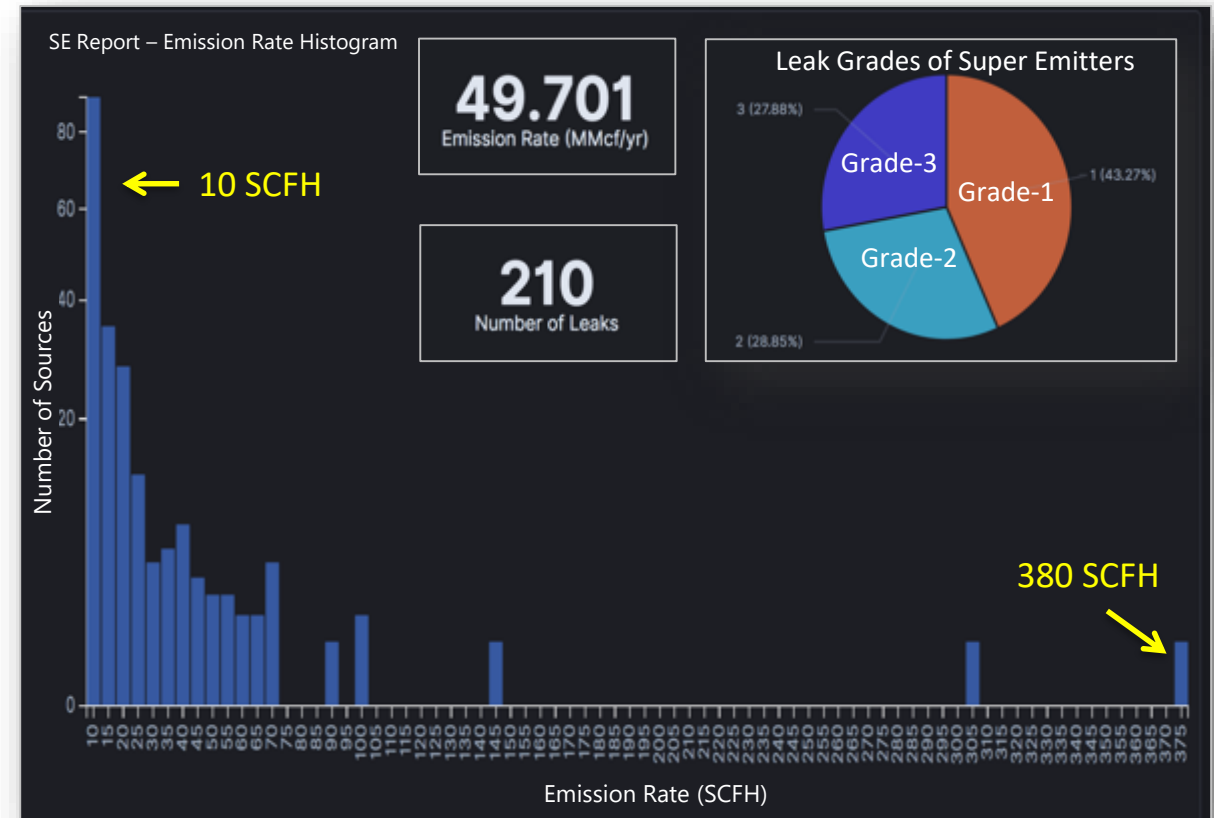- **10%** of leaks can typically contribute up to **50%** of emissions

P-Cubed dashboard used for super emitter leak identification and analysis

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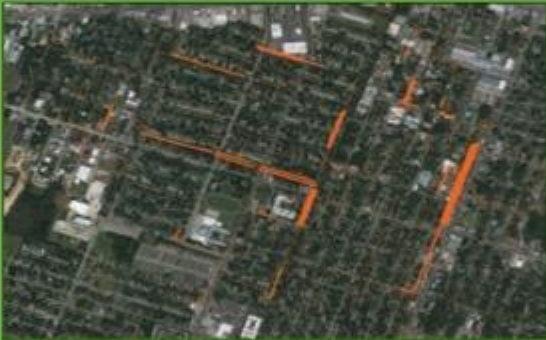# Case Study: Emissions Quantification / Reduction at Scale

PG&E 2018 Program to Identify Highest-Emitting Leaks for Prioritized Repair

- Picarro data collection on nearly **entire PG&E gas distribution system in 2018:**

  – Surveyed **1/3** of system for **compliance** & collected methane data on **2/3** of system for **emissions only**

- Identified **210 leaks** of **≥10 SCFH** accounting for **49.7 MMcf/yr of estimated emissions**

- Highest-emitting leaks prioritized for repair to take advantage of reduction in emissions

- Only **210 leaks** account for **32%** of PG&E's total distribution system emissions as measured by Picarro on assets covered by Picarro

- **74 Grade-1 leaks** remediated through the 2/3 non-compliance, emissions-only effort

SE Report – Emission Rate Histogram

49.701 Emission Rate (MMcf/yr)

210 Number of Leaks

Leak Grades of Super Emitters

3 (27.88%) Grade-3
1 (43.27%) Grade-1
2 (28.85%) Grade-2

10 SCFH

380 SCFH

Number of Sources

Emission Rate (SCFH)

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PIPE REPLACEMENT

Methane Data Mapping
yields
Replacement of Leakiest Pipes

Pipe Replacement Optimization

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Statement of the Problem...

How can we **optimize** our **pipe replacement** program:

– To maximize **removal of risk** across all threat types?

– To maximize **leak removal** using capital dollars?

– Within **budget** & planned mileage?

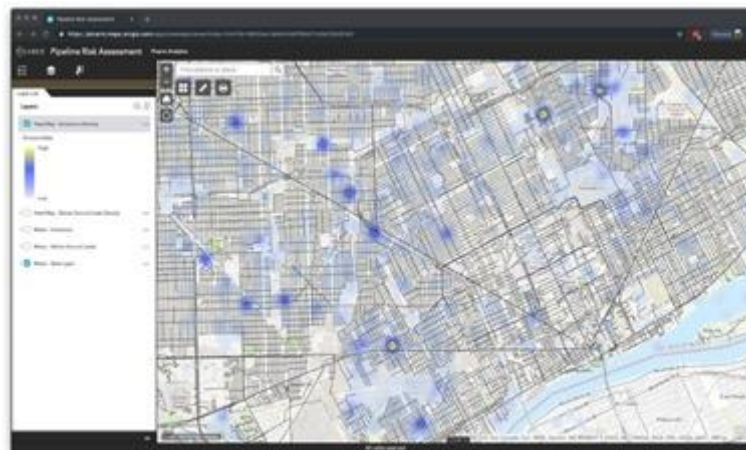– Be as **capital efficient** with pipe replacement dollars as possible?

I can only replace **one** of these pipe sections this year... all other things being equal, I'd chose to retire the **most leaks**...
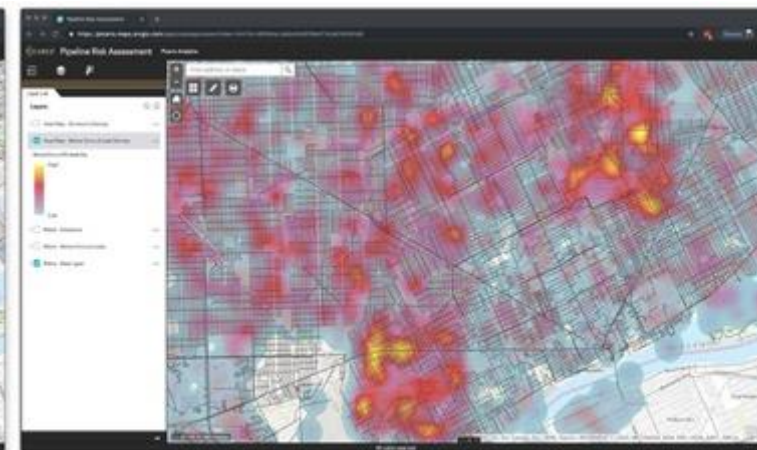

Leak count: 5
Emissions: 9.8 cu ft / hr

Leak count: 1
Emissions: 1.2 cu ft / hr
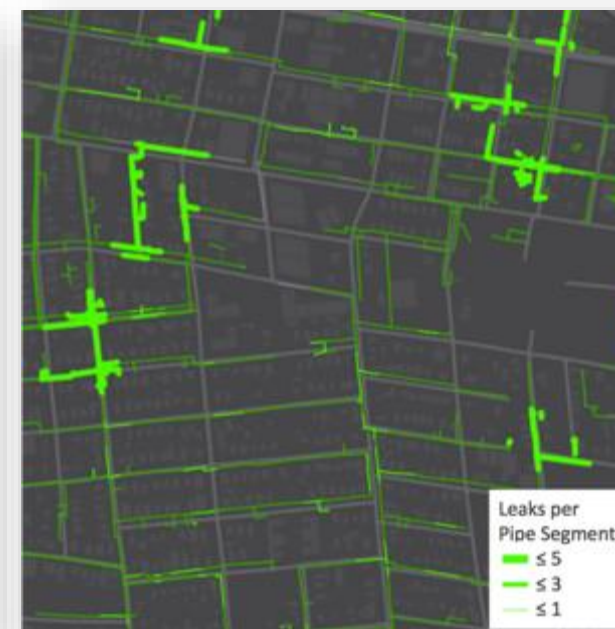
What if I knew **exactly** where **all** my leaks were?

Leaks per Pipe Segment
≤ 5
≤ 3
≤ 1

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Data-Informed Pipe Replacement Program

- Leverage leak survey drive data or independently drive system to capture data

- Picarro's analytics measure and attribute methane emissions to specific pipe segments

- Significant O&M cost avoidance
  - Allows enough lead time to replace pipe segments
  - Maximizes density of repaired leaks

- Emissions reduction

- Reduction in odor calls

Heat Map View – Emissions Density

Heat Map View – Below-Ground Leak Density

Mains View – Emissions
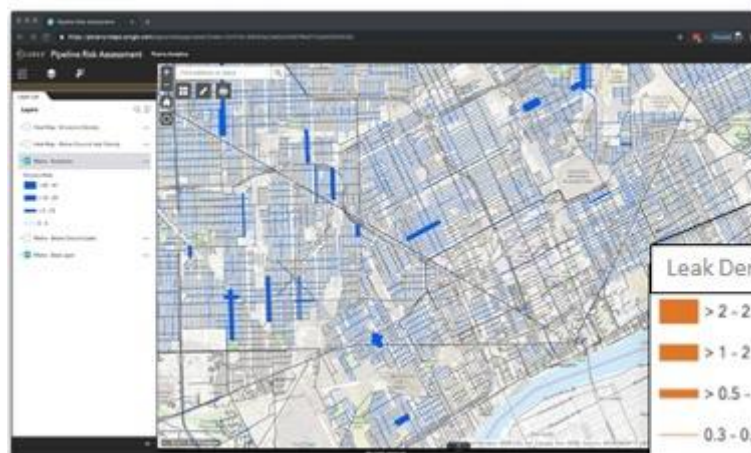
Mains View – Below-Ground Leaks

Leak Density/mi
> 2 – 2.8
> 1 – 2
> 0.5 – 1
0.3 – 0.5
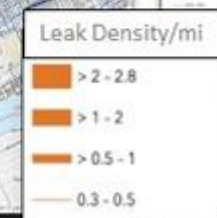
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Case Study: 276-mile Distribution System in Northeastern US

By making slight changes to the planned replacement projects, the number of leaks remediated (and repair cost avoided) by pipe replacement can be increased by 2x.

Picarro predicted leaks/mile in grids of 0.01sq mi
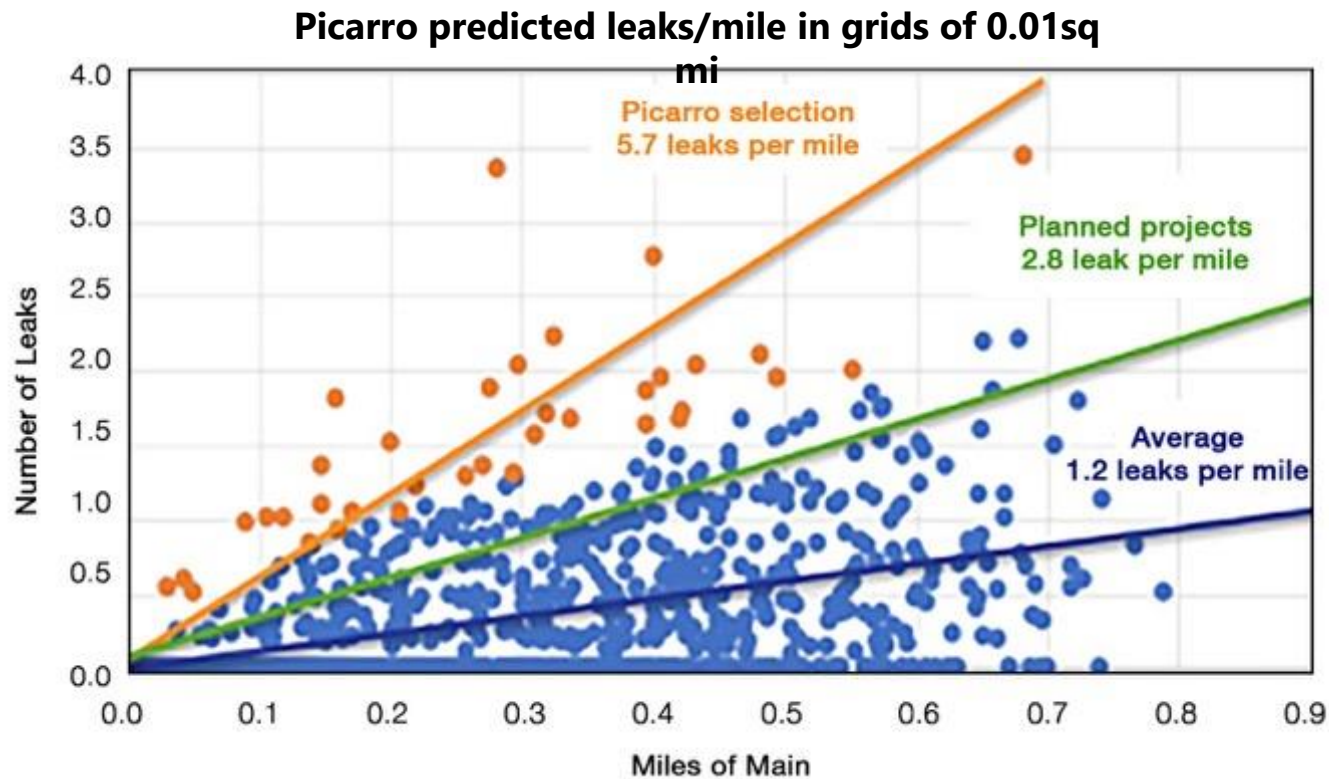
Picarro optimization would remediate 2x more leaks per mile as compared to the existing replacement strategy (5.7/2.8 leaks per mile = 2x)
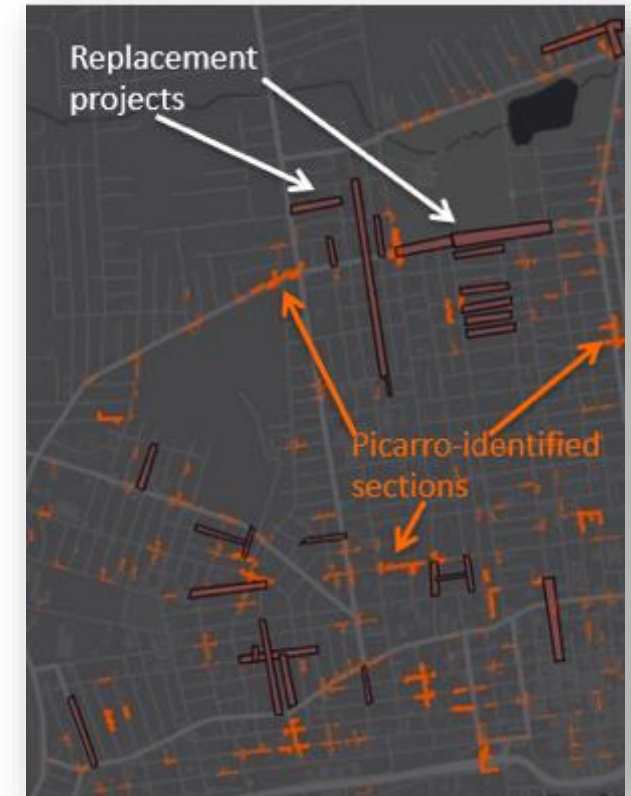
5% overlap between Picarro leak density assessment and proposed 2020 replacement projects

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Case Study: 276-mile Distribution System in Northeastern US

**Picarro Emissions Heat Map
of System in Case Study**

- **Picarro Pipeline Replacement Optimization Case Study:**

  – 276-mile distribution system in Northeastern U.S.

  – Remediates 2x more leaks by complementing existing pipeline prioritization processes AND achieve $1M in O&M expense avoidance *annually* over the 90 total miles replaced

  – The pipe replacement program identified 10 miles of main to be replaced in 2020 in this 276-mile subset

  – Picarro measurements estimate they contain 28 below-ground leaks.

  – Picarro optimization identified 10 (different) miles of main containing 57 below-ground leaks (2x) at $3500 per leak repair

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Thank You!

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